

**REMARKS/ARGUMENTS**

Claims 3, 4, 11, 13 and 17 have been amended. Claims 3, 4, 11-14, 16 and 17 remain pending in this application.

**Objection to the Disclosure**

The Examiner stated that “the equation on page 12, around line 14 is missing.” The equation, however, is not missing since it is set forth in lines 14 and 15 on page 12 as follows:

“The flow rate of the reaction gas (ml/h) /the amount of the catalyst (ml).”

**Rejection Under 35 USC § 112**

Claims 3-4, 11-14 and 16-17 stand rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement since they do not contain support for the limitations of “SO<sub>2</sub>F<sub>2</sub> produced by said decomposition of PFC” and “said toxic component containing at least one of SO<sub>3</sub> and HF produced by said decomposition of said PFC.” These claims have now been amended to overcome this rejection.

Claims 3-4, 11-14 and 16-17 also stand rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regarded as the invention in that “a toxic component” as defined in the second and fourth steps is unclear. These claims have now been amended to also overcome this rejection.

**Rejection of Claims Under 35 USC § 103**

Claims 3-4, 11-14 and 16-17 stand rejected under 35 103(a) as being unpatentable over EP 0885648 in view of JP 11-216455, Lang et al. (6,235,256), Bowker (4,687,543) and optionally further in view Geisler et al. (4,465,655).

Claims 3-4, 11-14 and 16-17 also stand rejected under 35 USC 103(a) as being unpatentable over Kanno et al. in view either JP 11-216,455, Lang et al (6,235,256), Bowker '543 and optionally further in view of Geisler '655.

**Patentability of the Claims**

Claims 3, 4, 11 and 13 have been amended to change “toxic component” to “hazardous component” in response to the Examiner’s objection that these claims were unclear. In addition, claims 3, 4, 11 and 13 have been amended by adding the terms NO and NO<sub>2</sub> which were inadvertently deleted in the washing step by the last amendment. Support for this change maybe found on page 4, lines 4-13 of the specification.

As discussed hereafter, it is submitted that the claims, as amended, remaining in the application patentably distinguish over the prior art.

Initially it is noted that the Examiner has relied on 6 different references, i.e., EP 0885648, JP11-216455, Lang et al. 6,235,256, Bowker 4,687,543, Geisler et al. 4,465,655 and Kanno et al. PG Pub US 2001/0001652, and rejecting claims 3-4, 11-14 and 16-17 as being unpatentable under 35 U.S.C. 103(a). In making these

rejections, the Examiner has stated at least nine times on pages 6-9 of the action that certain things “would have been obvious to one of ordinary skill in the art at the time the invention was made”. These instances are set forth on page 6, lines 17-21, page 6, line 21 to page 7, line 3, page 7, lines 5-7, page 8, lines 5-6, page 8, lines 7-9, page 8, lines 9-12, page 8, lines 13-16, page 8, lines 17-22 and page 9, lines 6-9.

Applicants submit that there is no teaching, suggestion or motivation in any of the cited references that would lead a person of ordinary skill in the art to combine their teachings in the manner done so by the Examiner to find the present invention as now claimed obvious. Indeed, the fact that 6 different references were required to find the invention obvious points more to the fact that the invention is unobvious and patentable rather than being obvious and unpatentable. To the extent that the present invention allegedly is obvious, it can only be obvious when viewed with the hindsight of Applicant’s teachings and would require a total reconstruction of the various cited references to arrive at Applicant’s invention. Even if some or all of the steps in Applicant’s claimed method maybe old steps known in the art, this does not necessary negate invention. The invention must be looked at as a whole in determining patentability.

Applicant’s invention and the references relied upon by the Examiner are discussed in detail hereafter.

It is therefore submitted that claims 3, 4, 11-14 and 16-17 are patentable.

The present invention deals with the decomposition of perfluorocompound (PFC) gases, particularly focusing on at least one of SF<sub>6</sub> and NF<sub>3</sub> out of the PFC

gases. The decomposition of these SF<sub>6</sub> or NF<sub>3</sub> gases typically includes two steps of processing. For example, decomposing SF<sub>6</sub> has two steps of processing: the first step is a PFC decomposing process and the second step is a hazardous component decomposition process. The first process passes SF<sub>6</sub> through a decomposition catalyst to decompose. This process produces a component SO<sub>2</sub>F<sub>2</sub> as a decomposition product. The second process contacts this component with a hazardous component decomposition catalyst to cause decomposition. These two steps of decomposition processing finally bring out decomposition products such as SO<sub>x</sub> (mainly SO<sub>3</sub>). Then, these decomposition products are allowed to be absorbed in water or alkaline aqueous solution in the cleaning tower to be washed away from the exhaust gas before exhausting the waste gas into the atmosphere.

As mentioned in the embodiment 1 described in the present specification, PFC generates a hazardous component containing SO<sub>2</sub>F<sub>2</sub> because of the PCF removing catalyst. Therefore, such a component is contacted with a hazardous component removing catalyst in order to be decomposed into SO<sub>3</sub>. The substance SO<sub>3</sub> is not obtainable by contacting only with a PFC decomposing catalyst but is obtainable to an acceptable extent by contacting further with a hazardous component removing catalyst.

As the present specification describes, however, the inventors have found a new problem that washing with water or an alkaline aqueous solution causes a part of HF, SO<sub>x</sub> NO<sub>x</sub> in the decomposition product to form a mist accompanied with H<sub>2</sub>O, and such mist clears the washing tower. For example, approximately 250-mol of

$H_2O$  accompanies 1-mol of  $SO_3$  to form the mist, which is exhausted into the exhaust line in the decomposition system. This new problem has led the inventors to the present invention.

More specifically, the newly found problems are: (1) that  $SO_3$  condenses when the temperature of the exhaust gas becomes below its dew point adhering on the inner wall of the exhaust pipe to cause choking thereof; (2) that the  $SO_3$  condensation also occurs on the exhaust blower adhering inside thereof to make the blower malfunction; and (3) corrodes the exhaust pipe or blower. It is clearly stated in the specification that the present invention has resulted from these newly found problems.

In addition, removing a highly corrosive mist by the mist removal apparatus eliminates the corrosion of an exhaust pipe or the like.

The emission of a part of HF,  $SO_x$  and  $NO_x$  in the decomposition product into the atmosphere should be eliminated as much as possible because such products adversely affect the environment.

As stated above, the decomposition products of HF,  $SO_x$  and  $NO_x$  are emitted directly into the atmosphere in the form of a gas. Such products in the form of a gas dissolve in water, which is emitted also into the atmosphere in a form of mist. These emissions cause a bad effect on the environment. The gas and the mist should therefore be removed completely to prevent deleterious effect to the environment.

For this purpose, the present invention uses a cyclone type apparatus to remove the gas and the mist eluded in the washing process.

In the mist removal process by the cyclone type apparatus, the gas and the mist eluded in the washing process are agitated in a very high speed swirl to cause them to be mixed rapidly to an extreme extent. Thereby, the decomposition products of HF, SO<sub>x</sub> and NO<sub>x</sub> gasses are absorbed in the mist. The mixing is required to be completed rapidly because the gas in the system flows swiftly. None of mist removal apparatuses other than the cyclone type can provide such rapid mixing to correspond with the swiftness of the gas flow.

In addition, the mist removal by the cyclone type apparatus can separate and remove very fine mists from non-hazardous gases. This means that the hazardous gases of decomposition products of HF, SO<sub>x</sub> and NO<sub>x</sub> are separated and removed from non-hazardous gas almost completely. This is a very noticeable and important effect.

With respect to the prior art relied upon by the Examiner, the invention defined in Lang '256 is a method of and an apparatus for wet-separation of gases, particularly acidic gases including SO<sub>2</sub>, HCl, or H<sub>2</sub>S, from exhaust gas using an absorbent of the alkali metal family or of the alkaline earth metal family such as limestone or dolomite. The reference, however, does not at all describe or suggest any origin-gas of the exhaust gas.

The Lang invention therefore is extraneous to the decomposing treatment of SF<sub>6</sub> and NF<sub>3</sub> defined in the present invention. Further, Lang does not anticipate any treatment such as that the present invention defines in which a two-stage arranged catalyst is used in the decomposition of SF<sub>6</sub> and NF<sub>3</sub>.

Moreover, Lang provides no description or implication of the decomposing of SF<sub>6</sub> or NF<sub>3</sub>. Further, Lang neither describes nor implies that the decomposition of these matters is performed using two stages of decomposition catalysts. Thus, it is clear as stated above that the present invention is a new subject and is completely different from Lang in terms of not only the composition but also the intended effects.

Lang describes a process of water washing for acidic gasses such as SO<sub>2</sub> HCl, and H<sub>2</sub>S in the scrubbing tower 1 having a demister of the first stage 3 and the second stage 4 to remove acidic gas component.

In Lang (see Fig. 1), the water spraying process is located in the downstream of the demister 4. This location results in leaving mists involved in the exhaust gas unremoved, which flow into the exhaust line, causing corrosion of exhaust pipes. In the decomposing of PFC gases of the carbon-series, the location likewise causes corrosion on the exhaust pipes or exhaust fans in the decomposition line because of HF that such decomposing process generates. This clarifies that the purpose of the present invention is to remove such mist completely from the exhaust gas. Therefore, the present invention is completely different from Lang in terms of not only the composition but also the intended effects.

The method of and an apparatus for wet-separation of gases defined in Lang corresponds to the exhaust gas washing tower 13 and its function defined in the present invention. Lang therefore does not anticipate the installing of an additional mist removal apparatus, nor the using of a cyclone type mist removal apparatus that the present invention uses.

The purpose of Lang is to provide a method of and an apparatus for removing a harmful acidic exhaust gas using an economical absorbent like limestone or dolomite.

In contrast, the purpose of the present invention is to provide a treatment method of PFC gas to lessen the corrosion of an exhaust blower or an exhaust pipe attributable to residual mist eluded in the washing process for removing the harmful decomposition products generated from the two-stage decomposition process of SF<sub>6</sub> and NF<sub>3</sub>. This purpose is entirely different from the purpose of Lang.

The effect that Lang provides is quite different from the effect by the present invention, because the effect of the present invention resides in that harmful decomposition products such as HF, SO<sub>x</sub> and NO<sub>x</sub> are almost completely removed and in that corrosion of an exhaust pipe or the like is prevented.

With respect to JP '455, this reference defines a method of and an apparatus for treatment comprising the steps of roasting an exhausted printed circuit board in water-vapor atmosphere or similar ambient, decomposing an exhaust gas generated from the roasting through an exhaust gas catalyst thermolysis apparatus 4 that uses a decomposition catalyst for oxides of matters such as Si, Al, Ti or Zr, washing the decomposed exhaust gas through an exhaust gas washing apparatus 5 that uses a substance such as alkali-matter-containing water, introducing the washed exhaust gas into a cyclone 8 to recover water there from, and removing the water recovered at the cyclone 8.

In the JP '455 invention, there also is no description or implication of the decomposing of SF<sub>6</sub> or NF<sub>3</sub>. Further, JP '455 neither describes nor implies that the decomposition of these matters is performed using two stages of decomposition catalysts. Thus, it is clear that the present invention has been made based on a new subject and is completely different from JP '455 in terms of not only the composition but also the intended effects.

The JP '455 does not mention any specific composition of the decomposition products that may be generated from the decomposing of exhausted printed circuit boards. This means that the reference does not have any need for a decomposition arranging catalyst in the exhaust gas catalyst thermolysis apparatus 4 in two-stage.

Therefore, JP '455 does not anticipate or render obvious a decomposition method as defined in the present invention that uses separate catalysts arranged in two stages.

The problem that the present invention handles, wherein SF, SO<sub>x</sub> and NO<sub>x</sub> gases generated from the decomposing process with the two-stage-arranged catalysts are absorbed in mists involved in the exhaust gas washed with water or an alkaline aqueous solution and such mists condense on parts as the exhaust pipe, causing corrosion thereof, is not described or suggested in JP '455 at all.

The JP '455 invention describes that the exhaust gas passes the exhaust gas cleaning unit 5 then goes into a cyclone to have water removed there from, wherein removed water, disposal-water, is gathered and recycled to the exhaust gas cleaning unit 5 for re-use. The JP '455 reference however does not describe or suggest the

decomposition products of HF, SO<sub>x</sub> and NO<sub>x</sub> defined in the present invention, or further that these gases will corrode parts such as the exhaust pipe.

As stated above, the cyclone type mist removal apparatus in the present invention is capable of agitating rapidly gas and mist after washing. Thereby the decomposition products of HF, SO<sub>x</sub> and NO<sub>x</sub> are absorbed in the mist and corrosion is largely reduced. This is a newly found effect and the present invention has been made based on this finding.

The mist removal using the cyclone type mist removal apparatus can separate and remove very fine mists from the gas. Harmful decomposition products of gas of HF, SO<sub>x</sub> and NO<sub>x</sub> are therefore separated and removed and the gas rendered harmless.

The purpose of JP '455 is to provide a method of and an apparatus for treatment of an exhausted printed circuit board, wherein the method does not emit any harmful exhaust gas while processing for recycling or harmless-rendering.

In contrast, the purpose of the present invention is to provide a treatment method of PFC gas to lessen the corrosion of an exhaust blower or an exhaust pipe attributable to residual mist eluded in the washing process for removing the harmful decomposition products generated from the two-stage decomposition processing of SF<sub>6</sub> and NF<sub>3</sub>. This purpose is entirely different from the purpose of JP '455.

Thus, the present invention is not such an idea that the JP '455 reference anticipates nor such an invention as can be easily derived therefrom.

The EP '648 reference refers to a decomposition treatment of fluorine compound gas such as a SF<sub>6</sub> and NF<sub>3</sub> using a specific catalyst produces SO<sub>x</sub> (mainly SO<sub>3</sub>). The EP '648 invention neither describes nor implies that the decomposition of these matters is performed using two stages of decomposition catalysts. Thus, it is clear that the present invention is completely different from EP '648 in terms of not only the composition but also the aimed effects.

The EP '648 reference does not describe or suggest at all any aspects such as that the decomposition of NF<sub>3</sub> or SF<sub>6</sub> generates SO<sub>2</sub>F<sub>2</sub>. This means that EP '648 does not have a need for a decomposition of a generated harmful component of SO<sub>2</sub>F<sub>2</sub>. Therefore, the cited art does not anticipate at all a decomposition method using a harmful component decomposition catalyst at the rear stage of the PFC decomposition catalyst.

The EP '648 invention provides an exhaust gas cleaning tank for washing the exhaust gas after decomposing SF<sub>6</sub> and NF<sub>3</sub> with water or an alkaline aqueous solution. The reference, however, provides no description or implication of removal of washing-caused mists after such a washing process. The reference further describes that the decomposing SF<sub>6</sub> and NF<sub>3</sub> is performed at a lower temperature with increased efficiency and that the working life of the decomposition catalyst used and associated decomposition processing unit are lengthened thereby. This description, however, gives no suggestions for the removing of mists. Therefore, the present invention is different from the cited reference in composition and aimed effects.

The EP '648 reference does not mention at all such aspects that not only the gas, which includes decomposition products generated from said decomposition treatment of  $\text{NF}_3$  or  $\text{SF}_6$ , is washed with water or an alkaline aqueous solution, but also that such washing causes a part of  $\text{HF}$ ,  $\text{SO}_x$ ,  $\text{NO}_x$  included in said decomposition product to form mist accompanied with  $\text{H}_2\text{O}$ , and that such mist is emitted into the atmosphere clearing the washing tower. Further, there is no description at all about the removal of  $\text{HF}$ ,  $\text{SO}_x$ ,  $\text{NO}_x$  before exhausting into the atmosphere.

It is evident that the present invention is made based on a new problem found in the washing of the gas including decomposition products with water or alkaline aqueous solution. The subject matter on which the present invention is based is a newly found problem that residual mists in the exhaust gas after washing corrode the exhaust blower or exhaust pipe. This matter is not indicated in the EP '648 reference at all. Accordingly, there is no conception of removing residual mists therein. Therefore, there is no idea of equipping mist removal equipment or cyclone type mist removal apparatus in the reference. The purpose of the EP '648 reference is to provide a decomposition method that efficiently decomposes fluorine-containing matters or fluorine compounds under lower temperatures. In contrast, the purpose of the present invention is to provide a treatment method of PFC gas to lessen the corrosion of an exhaust blower or an exhaust pipe attributable to residual mist eluded in the washing process for removing the harmful decomposition products

generated from the two-stage decomposition processing of  $AF_6$  and  $NF_3$ . This purpose is entirely different from the purpose of EP '648.

Thus, the present invention is not such an idea that the EP '648 reference anticipates nor such an invention as can be easily derived therefrom.

The Kanno '652 reference describes that decomposition treatment of a PFC gas such as  $C_2F_6$  and  $NF_3$  produces  $HF$ ,  $NO_x$  (mainly  $NO$ ,  $NO_2$ ), that these decomposition products are made to be absorbed in water or alkaline aqueous solution in a washing tower so that they become washed and that the washed decomposition products are then emitted into the atmosphere.

In Kanno, there is no description or implication of the decomposing of  $SF_6$ . Further, Kanno neither describes nor implies that the decomposition of these matters is performed using two stages of decomposition catalysts. Thus, it is clear that the present invention is completely different from Kanno in terms of not only the composition but also the intended effects.

Kanno does not mention at all such aspects that the washing of the gas, which includes decomposition products generated from said decomposition treatment of  $NF_3$ , with water or alkaline aqueous solution causes a part of  $SO_3$  included in the decomposition product to form mist accompanied with  $H_2O$  and that such mist is emitted into the atmosphere clearing the washing tower. Further, there is no description at all about the removal of  $SO_3$  before exhausting into the atmosphere. Kanno does not describe or suggest that the decomposition of  $NF_3$  or  $SF_6$  generates  $SO_2F_2$ . This means that the reference does not have a need for a

decomposition of a generated harmful component of  $\text{SO}_2\text{F}_2$  and does not anticipate a decomposition method using a harmful component decomposition catalyst at the rear stage of the PFC decomposition catalyst.

The Kanno reference provides an exhaust gas cleaning tank for washing the exhaust gas after decomposing  $\text{NF}_3$  with water or alkaline aqueous solution but provides no description or implication of removal of washing-caused mists after such a washing process. The reference further describes that the decomposing of  $\text{NF}_3$  is performed at a lower temperature with increased efficiency and that the working life of the decomposition catalyst used and associated decomposition processing unit are lengthened thereby. This description, however, gives no suggestion for the removing of mists. Therefore, the present invention is different from the reference in composition and intended effects.

In contrast to this, the present invention, as stated above, is based on a problem newly found in the washing of such a gas, which includes decomposition products, with water or alkaline aqueous solution. The newly found problem is that residual mists in the exhaust gas after washing corrode the exhaust blower or exhaust pipe. This matter is not indicated in Kanno at all, and accordingly, there is no conception of removing residual mists therein. Therefore, there is no idea of equipping mist removal equipment or cyclone type mist removal apparatus in Kanno.

The purpose of the Kanno invention is to provide a decomposition method that efficiently decomposes fluorine-containing matters of fluorine compounds under lower temperatures. In contrast, the purpose of the present invention is to provide a

treatment method of PFC gas to lessen the corrosion of an exhaust blower or an exhaust pipe attributable to residual mist eluded the washing process for removing the harmful decomposition products generated from the two-stage decomposition processing of SF<sub>6</sub> and NF<sub>3</sub>. This purpose is entirely different from the purpose of Kanno.

The present invention is not such an idea that Kanno anticipates nor such an invention as can be easily derived therefrom.

The Geisler '655 reference describes a purification method of an exhaust gas contaminated with SO<sub>2</sub>F<sub>2</sub>, a decomposition product of SF<sub>6</sub> wherein SO<sub>2</sub>F<sub>2</sub> is removed by washing the exhaust gas with an alkali metal aqueous solution of 5% sodium hydroxide using activated carbon as a catalyst. The reference, however, does not describe or suggest at all decomposition of SF<sub>6</sub> or NF<sub>3</sub>, or use of a two-stage-arranged decomposition catalyst in the decomposition process. Accordingly, the present invention completely differs from the Geisler in composition and effect.

The subject matter on which the present invention is based is a newly found problem that residual mists in the exhaust gas after washing corrode the exhaust blower or exhaust pipe. This matter is not indicated in Geisler at all and accordingly, there is no conception of removing residual mists therein. Therefore, there is no idea of equipping mist removal equipment or cyclone type mist removal apparatus in Geisler.

The purpose of Geisler is to completely remove sulfuryl fluoride from exhaust gases to form fluoride and sulfate ions in accordance with equation (1) with

maximum utilization of the alkali available. In contrast, the purpose of the present invention is to provide a treatment method of PFC gas to lessen the corrosion of an exhaust blower or an exhaust pipe attributable to residual mist eluded in the washing process for removing the harmful decomposition products generated from the two-stage decomposition processing of SF<sub>6</sub> and NF<sub>3</sub>. This purpose is entirely different from the purpose of Geisler.

The present invention is not such an idea that the Geisler reference anticipates nor such an invention as can be easily derived therefrom.

The Bowker '543 reference describes removal of an insulating layer of Si<sub>3</sub>N<sub>4</sub>, SiO<sub>2</sub> by a plasma etching in an atmospheric gas containing sulfur hexafluoride and fluorocarbon as etching agents. The reference, however, does not describe or suggest at all decomposition of SF<sub>6</sub> or NF<sub>3</sub>, or use of a two-stage arranged decomposition catalyst in the decomposition process. Accordingly, the present invention completely differs from Bowker in composition and effect. The Bowker invention removes the insulating layer of an integrated circuit with the plasma etching. Bowker completely differs from the treatment method defined in the present invention that decomposes SF<sub>6</sub> and NF<sub>3</sub>, washes, and removes mists after the washing. There is no idea of equipping mist removal equipment or cyclone type mist removal apparatus in Bowker.

The purpose of Bowker is to provide desired selectivity in plasma etching without undesired polymer coating of plasma chamber. In contrast, the purpose of the present invention is to provide a treatment of PFC gas to lessen the corrosion of

an exhaust blower or an exhaust pipe attributable to residual mist eluded in the washing process for removing the harmful decomposition products generated from the two-stage decomposition processing of SF<sub>6</sub> and NF<sub>3</sub>.

The effect that Bowker provides is quite different from the effect of the present invention, which resides in that harmful decomposition products such as HF, SO<sub>x</sub>, and NO<sub>x</sub> are almost completely removed and in that corrosion of an exhaust pipe or the like is prevented. Thus, the present invention is not such an idea that the Bowker reference anticipates nor such an invention as can be easily derived therefrom.

Therefore, the present invention is not such invention that a person skilled in the art could derive from these cited references as being obvious.

**Conclusion**

In view of the foregoing amendments and remarks, the Applicants request reconsideration of the rejection and allowance of the amended claims.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of Mattingly, Stanger & Malur, P.C., Deposit Account No. 50-1417 (referencing attorney docket no. NIP-198).

Respectfully submitted,

MATTINGLY, STANGER, MALUR & BRUNDIDGE, P.C.

/GENE W. STOCKMAN/

Gene W. Stockman  
Registration No. 21,021

GWS/jab  
(703) 684-1120